24th North American Moose Conference

ABSTRACTS

88-05809/

OCCURRENCE OF PROSTRONGYLID NEMATODES IN THE MOOSE OF MINNESOTA

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OCCURRENCE OF PROSTRONGYLID NEMATODES IN THE MOOSE OF MINNESOTA

Over the last ten years the moose population in northeastern Minnesota has gradually increased coincident with a gradual increase in the deer population. Previous research has suggested that mortality should increase in moose populations from *P. tenuis* infection as deer density increased. To determine whether the rate of *P. tenuis* infection is related to deer density, a project was initiated to identify what proportion of the moose are infected and how this infection rate varies according to deer density. Fecal samples were collected from hunter killed moose and analyzed using the Baermann technique. From a total of 562 samples from both the northeastern and northwestern moose populations, *P. tenuis* larvae were found in only three samples. While this low infection rate precludes evaluation of the importance of deer density, it raises questions regarding the importance of *P. tenuis* infection as a mortality source in moose populations.

MOOSE DAMAGE TO PRE-COMMERCIALLY THINNED BALSAM FIR (Abies balsamea) STANDS IN NEWFOUNDLAND

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Abstract: In many areas of Newfoundland dense balsam fir stands dominate sites after logging. At about 10-12 years of age, these stands are mechanically thinned to reduce stem density from about 50,000 stems/ha to 3000 stems/ha. Thinning enhances tree growth through reduction of competition for light and nutrients. After one year of post-thinning growth, stands are often heavily browsed by moose, while adjacent unthinned stands receive little damage. An island-wide survey of 21 stands showed that moose had browsed 3 - 45 percent of firs taller than 1.8 m, and severly damaged (more than 50 percent current growth and leader removed) up to 22 percent of the tall stems in some stands. Comparison of thinned and unthinned stands using densities of fir, spruce, and hardwoods as trees and shrubs, average tree and shrub heights, and distance from uncut stands as variables in stepwise multiple regression analysis, indicated that balsam fir density was the only significant variable, explaining 82 percent of the variance. We also studied moose browsing on a spacing trial of 1.2, 1.8, 2.4, and 3.0 m between firs on 5 ha plots (3 plots of each spacing). Moose damage was significantly higher on the two widest spacings compared to the two narrow spacings and compared to unthinned control plots. These data suggest twig composition of balsam fir is more favourable to moose after inter-tree competition is reduced as a result of thinning. Recommendations for management to reduce damage are discussed.

HABITAT USE BY MOOSE IN SOUTHWESTERN ALBERTA

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Moose (Alces alces shirasi) numbers and use of habitat were studied on the Streeter Basin Experimental Watershed between 1969 and 1983. The area is in the montane aspen zone of the foothills of the Rocky Mountains. Winter habitat use was measured by pellet counts and direct observation. Climatic influences were also evaluated. Moose winter use of was very high in shrubland, significantly high in dense aspen forest and low in herbland. Upper slopes were selected to a significant degree while lower slopes were rejected. Exposures facing away from the sun were significantly preferred to sunny exposures. Slopes were used in the same proportion as available. In spring moose used cover types in proportion to their occurrence but increased their use of upper slopes. Shaded aspects were strongly preferred. Summer use of herbland increased while a smaller percentage of observations was made in shrubland. Use shifted strongly to lower slopes but the strong preference for shaded exposures remained. Winter use of shaded exposures probably results from the occurrence of more browse-producing aspen forest and shrubland on those exposures. Evidence suggests moose move into the Basin after substantial snow storms. However, in periods of deep snow cover moose move down to lower elevations. Spring and summer observations reflect greater movement in open areas and selection of cooler shaded locations on lower, north and east facing slopes, especially those with aspen forest.

HUNTER QUESTIONNAIRES AND HARVEST MANAGEMENT ("AROUND THE CIRCLE")

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The influence of non-response on harvest estimation by questionnaire was documented for the 1986 general moose season. Estimates generated from respondents to two mailings and non-respondents (bias-reduced method) were compared to estimates generated in a manner similar to the standard method. Two groups of licencees were sent questionnaires on different dates as related to when licence stubs were received. The groups differed ($p < .05$) relative to four characteristics. Success rate of respondents (23.1%) was greater ($p < .01$) than that of non-respondents (14.6%). Total harvest was estimated at 1175 moose by the standard method and 950 moose by the bias-reduced method. The standard method over-estimated harvest by 15.2% for the early season and 43.0% for the late season. The standard method over-estimated harvest in Game Hunting Area 26 by 64.4%. Response rate varied widely between communities. Winnipeg residents respond at a greater rate than hunters residing outside of Winnipeg. A modified wave method over-estimated total harvest by 2.6%, early season harvest by 2.1% and late season harvest by 3.5%. The impact of non-response bias on the ability to manage harvest can be reduced through standardization of methodology, achievement of a high response rate and the sampling of non-respondents. The wave method offers considerable promise.

CHANGES IN BODY COMPOSITION OF MOOSE DURING WINTER

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Nine adult moose (Alces alces) were assigned to 1 of 3 treatments in 2 separate trials. In trial 1, 3 treatment groups of 3 moose were fed a pelleted diet at ad libitum (high), or 85 (medium), and 70% (low intake) of ad libitum intake. During trail 2, 3 treatment groups of moose were fed at ad libitum intake 1 of 3 pelleted diets containing a metabolizable energy (ME) content of 2.4, 2.1, and 1.8 kcal/g dry matter. Estimates of body composition were determined with tritiated water. In trial 1 moose fed restricted quantities (85 or 70% ad libitum intake) of food lost weight and fat at faster rates than moose fed at ad libitum. The percentage change in kg of fat from pretrial measurements in October until trial end in April was 33.0, 26.8, and -57.2% for the high to low intake treatments, respectively. In trial 2, moose fed 1.8 and 2.1 kcals ME compensated for lower levels of available energy by increasing dry matter intake. Fat dynamics were not different ($p > 0.05$) among the treatments but different ($p < 0/05$) over time. Change in the energy pool indicated that fat catabolism/metabolism contributed about 94.7-108% of the calories, although the variation was high. Estimates of body composition based on the tritiated water technique were variable, and reasons are discussed.

FOOD PASSAGE RATE IN MOOSE

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Four tame moose (Alces alces) were used to measure dry matter digestion and rates of passage of three diets: a pelleted ration, a mixture of pellets and winter clipped aspen (Popuus tremuloides), and a mixture of winter clipped aspen, willow (Salix spp.) and paper birch (Betua papyrifera). Dry matter digestion was greatest for the pellets (64.3%) followed by the pellet-aspen mix (60.5%) and the mixed browse (42.0%). Time of first appearance, rumen turnover time and total mean retention time for both the solid and liquid phases of digesta were longest for the mixed browse diet. There was significant correction (r=0.97. P(0.05) between the movement of the solid and liquid components of digestion.

MIGRATION DISTANCES OF MOOSE POPULATIONS IN RELATION TO RIVER DRAINAGE LENGTH

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To aid in management of migratory moose populations in Sweden we would like to develop a method of using an easily measured geographical feature to predict the summer and total distribution of populations, based on winter inventory data. As a first step in developing such a method, we compared the migration distances of moose in 12 populations to the upstream lengths of the river drainages that the winter concentration areas were located along. The populations were from both coastal and mountainous inland regions throughout central and northern Sweden. We found that mean and maximum migration distances of moose in the different populations were correlated to the length of the respective river drainage, and that with rare exception moose migrated upstream from winter to summer areas. Thus river drainage length and direction of flow appear to be major factors affecting the direction and maximum distances that moose in winter concentration areas migrate. By noting the location of a winter concentration area along a river drainage, it may be possible to estimate the approximate area of the population's total summer distribution.

HUNTER SATISFACTION WITH THE SELECTIVE HARVEST SYSTEM FOR MOOSE MANAGEMENT IN ONTARIO

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In response to a declining moose population in Ontario, a selective harvest system has been introduced in the province. This paper examines the perceptions of hunters to this new management strategy as measured in studies conducted in 1985, 1986 and 1988, and how these perceptions have influenced subsequent revisions to the selective harvest system.

Hunter attitudes to the selective harvest system were found to be somewhat polarized, with many hunters supportive of the system, but many hunters not supportive. To explain this variation in attitude, a number of variables were explored in relationship to attitude. Hunter knowledge of the biological principles underlying the selective harvest system was found to be the major variable significantly related to hunter attitudes. Further, many hunters were opposed to the elimination of "party hunting" in the selective harvest system. In fact, many hunters admitted they were not complying with this regulation.

Faced with these concerns expressed by hunters, the Ontario Ministry of Natural Resources revised the selective harvest system to allow a limited amount of party hunting. In addition, a vigorous campaign was introduced to provide hunters with an understanding of the biological principles of the selective harvest system. Reflecting from this process, a number of implications are discussed regarding the appropriateness of social science research in natural resource management.

OUTPUT OF FIRST-STAGE PROTOSTRONGYLID LARVAE IN KNOWN AGE WHITE-TAILED DEER IN NORTHEASTERN MINNESOTA

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Fecal pellets collected from car-killed white-tailed deer (Odocoileus virginianus) were examined for first-stage protostrongylid larvae. Earliest date of occurrence in fawns was October 30. However no other samples from fawns yielded larvae until mid-December; output intensities ranged from less than 0.1 to 78.4 larvae per gram of feces. Frequency of occurrence increased through winter and during March nearly half the samples from fawns contained larvae; output intensities sometimes exceeded 100 larvae per gram of feces. Samples from yearling and adult deer generally had low output intensities during fall and early winter; but intensities sometimes exceeded 100 larvae per gram of feces during the period of late-December through March. Data will be collected for another two to three years so that increased fall and winter sample size will allow for detection of age- and/or sex-specific differences in larval output in yearling and adult deer as well as to define larval output during summer.

THE HUNTING RIGHTS OF INDIAN PEOPLE IN MANITOBA: AN HISTORICAL OVERVIEW AND A CONTEMPORARY EXPLICATION TOWARD ENHANCED CONSERVATION INVOLVING DEVELOPMENT OF COOPERATIVE AND JOINT WILDLIFE MANAGEMENT PROGRAMMING.

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Hunting, fishing, gathering and trapping were the industries of the aboriginal societies of North America. The British Government recognized these rights, at the time of re-settlement of North America. The right to hunt and fish was later enshrined in treaty and Acts of Parliament, including the Canadian Constitution Act, 1982. The provisions of Canadian law are such that conventional wildlife management practice (i.e. harvest restrictions) cannot be effected in managing wildlife populations which are hunted by Indian people in Manitoba. Co-operative wildlife management is a venture based on a trust relationship between an Indian band usually represented by Chief and Council and staff of the Wildlife Branch. Both parties benefit from such agreements without associated cost or sacrifice. Indian rights to hunt are not compromised: on the contrary, the agreements serve to enhance those rights, through the production of more game. The agreements are statements of goodwill and have no force in law. Joint management agreements would provide for investment of decision making authority with Indian people in recognition of hunting rights and enhanced conservation on the landscape.

MOOSE HABITAT MAPPING IN CENTRAL NEWFOUNDLAND USING LANDSAT THEMATIC MAPPER DATA

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Earth Resources Satellite sensors are increasingly used to provide rapid and current mapping of large areas for wildlife habitat analysis. In 1986 the Newfoundland Wildlife Division undertook an experimental project to assess the feasability of Landsat Thematic Mapper data to classify and inventory moose habitat. A TM digitized format was selected because of its superior 30 m resolution, seven spectral bands, and convenient summary statistics. An area for which considerable moose population data were available, Moose Management Unit 24 (Northwest Gander), was chosen as the project study area. Cloud-free imagery for this area was available from August 26, 1985. Analysis of the digital data was performed on a DIPIX ARIES-III image analysis system located at NORDCO Limited in St. John's. Surface verification ("ground-truthing") and accuracy assessment was provided by 1:40,000 colour infrared aerial photography acquired in 1983, 1:12,500 provincial forest inventory maps compiled in 1978, as well as ground and aerial surveys in 1986 and 1987. Twelve cover types were identified using a supervised classification. Habitats notable for moose included mature hardwoods, immature conifers, recent cutovers/slash, immature hardwoods, mature mixed forest, and mature conifers. Long-term objectives currently being addressed include using classified cover types to stratify habitat for population surveys, and to evaluate changes in moose habitat potential for the various MMU's across the Island.

THE BIOLOGY OF NEMATODIRELLA ALCIDIS IN MOOSE OF NORTHWESTERN ONTARIO

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Examination of the feces, abomasa and duodenums of wild moose (*Alces alces*) from Northwestern Ontario revealed the presence of only two species of gastro-intestinal helminths. *Nematodirella alcidis* was present in 19 of 20 (95%) animals examined. Eggs of *Monezia* sp. were detected in the feces of 2 of 17 animals. The mean intensity of infection with adult *N. alcidis* was 32 worms. Inhibited fourth-stage larvae of *N. alcidis* were commonly observed and generally were more numerous than adults. Host age, sex, and season did not appear to affect the prevalence or intensity of infection with *N. alcidis*. This differed markedly from the situation seen in caribou (*Rangifer tarandus*) with *Nematodirella longissimespiculata*. Caribou harbour more worms than moose, few of which are fourth stage larvae. Generally, they are not infected as adults, and demonstrate a marked seasonality of infection.

COLARADO MOOSE: REINTRODUCTION AND MANAGEMENT

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Moose (Alces alces shirasi) were trapped in Utah in 1978, Wyoming in 1979, again in Wyoming in 1987 and released in a mountain park in north central Colorado. The 28 original moose released in 1978 and 1979 have increased to approximately 250 animals statewide by 1988 despite heavy illegal losses. Emigration of moose has successfully established breeding populations outside of the original release areas, and moose have been documented over 100 km from that area. A moose management unit was established, and limited hunting for a small number of bulls started in 1985. In 1987, twelve additional moose were trapped in Wyoming and released approximately 50 km northeast of the original release site to establish a supplemental herd and increase expansion potential. A management plan was developed in 1986-87 that outlined current and future population estimates, inventory efforts, habitat monitoring, harvest projections and public concerns. This paper discusses public relation efforts to reduce illegal kill, consumptive and nonconsumptive values, current and future management plans, game damage, and future reintroductions in Colorado.

MOOSE AGE DETERMINATION: THE STATUS OF APPLIED MANAGEMENT AGING TECHNOLOGY AND GOALS FOR CENTURY 21

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A survey of North American jurisdictions is the basis of a report on applied moose ageing methodology. The literature is reviewed with respect to progress in aging technology, and validity of applied techniques. Barriers limiting use of currently available advanced techniques in applied circumstances are examined. The possibilities for enhancement or eclipse of current technology are examined.

LARGE AREA MOOSE CENSUS IN NORTHERN MANITOBA

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A moose census for the 152 000 km² Northern Flood Agreement (NFA) area in northern Manitoba was designed and flown. Expeditious completion of the census within fiscal limitations was fundamental to the survey design. Satellite (Landsat) multi spectral scanning data were used to classify and map winter moose habitat. Stratification was based on the habitat maps and the previous 30 years' fire history. A random selection procedure was used to select variable size sample plots within 5 habitat types (strata). Plot shapes were irregular and followed geographic features for easy definition. Plot boundaries did not cross habitat boundaries. Between November 1983 and December 1987 two censuses of the NFA area were completed. Study areas in a given year ranged between 14 000 and 78 000 km². Samples totalling 10 to 18% of the productive moose habitat returned population estimates with 95% confidence intervals of 36 to 40% of the estimate. When stabilized using Taylor's Power Law 96% of the variance was accounted by contagious distribution of moose.

When censusing large areas the investigator must be perceptive to changes in moose distribution and densities. Intra-type habitat differences or gradients should be delineated. Any single one or combination of these factors may require dividing the area into 2 or more census areas for analyses purposes. The survey design is able to accomodate post-census divisions.

SPACE UTILIZATION BY FEMALE MOOSE IN SOUTHWESTERN QUEBEC

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Abstract: Eighty radio-collared female moose were monitored in La Vérendrye game reserve between 1981 and 1986, which yielded 1555 locations mostly made with helicopter. Mean daily distance travelled averaged 0.5 km over the year, but monthly differences were significant; daily distances were minimum in late winter and maximum just before parturition. Females with calves were more sedentary ($\bar{X}$ = 0,3 km/d) than those without youngs ($\bar{X}$ = 0,7 km/d), except in September and October when the tendency was reversed. Females without calves remained generally solitary between June and August but associated in groups of 2 to 3 animals between November and April. Female with calves stayed mostly in family group all the year round. Home range sizes were estimated for 32 animals which were located at least 45 times. Home range size exibited marked individual variations. They covered, on average, 29 km^2 and 27 km^2 in summer and winter respectively. Preliminary results indicate that home ranges often overlaped between summer and winter and from year to year.

WINTER UTILIZATION BY MOOSE OF GLYPHOSATE TREATED CUTOVERS - AN INTERIM REPORT

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Abstract: The herbicide glyphosate is being used as an important silvicultural tool in Ontario's Boreal Forest. It is normally applied aerially as a conifer release treatment after planting to control competing vegetation. A three-year study was initiated in 1986 to examine changes in vegetation and density, and how these changes affect the winter utilization by moose (Alces alces). Four cutover areas, ranging from 76 to 170 hectares, aerially treated with glyphosate, were selected as study sites in north-central Ontario. Each was paired with an adjacent non-treated control having a similar history of cut and pre-spray silvicultural treatment. Moose winter utilization of treated and non-treated areas was assessed by spring browse and pellet group surveys, and twice weekly aerial surveys, December through March, 1986-87 and 1987-88. The glyphosate treated areas showed less usage by moose than adjacent controls, one and two growing seasons post-treatment. The total available biomass of principle moose browse species was reduced ($P < 0.5$) in treated cutovers. The resulting decrease in moose utilization is presumed to be temporary. This on-going study will attempt to determine the duration and extent of recovery.

GROWTH OF A MOOSE HERD IN A PREDATOR FREE ENVIRONMENT

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Prior to 1900 moose were common in the Turtle Mountain area of Southwestern Manitoba and Northern North Dakota. Archival reports indicate that moose, along with elk, mule deer, black bears and wolves occupied this wooded island in the prairies but disappeared soon after the turn of the century. In the last decade, however, the moose has reinvaded the Turtle Mountain area on both sides of the international border. Population growth appeared to be slow during the early 1980's but in recent years, the herd has grown rapidly. Land use on the North Dakota part of the Turtle Mountain uplands is more intensive than in Manitoba which probably limits the growth potential of the herd more so than in Canada.

Aerial surveys conducted during the winters of 1985/86, 86/87 and 87/88 indicate an expanding healthy population. The history of moose and their rapid population growth since reinvasion, in an area that is free of large carnivores is summarized as well as future management plans and problems.

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Traditional uses of wildlife in North America are threatened by increasing public acceptance of ideas advanced by the animal rights movement and the "protest industry". Widespread, negative economic, social and biological impacts upon wildlife resources - and those who depend on them - will result unless this trend is reversed. Public wildlife agencies must reassess their priorities and divert human and financial resources to meat the animal rights challenge. We are in trouble but the issue can be favourably resolved if it is understood in continental, not local, terms and approached with a long-term strategy.

MODELLING A HUNTED MOOSE POPULATION IN NEW BRUNSWICK

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Abstract: To explore the role of hunting in population dynamics, a deterministic simulation model was built to mimic a real moose (Alces alces) population in a 2396 km^2 area of southeastern New Brunswick. Data from moose population statistics in southeastern New Brunswick were used to initialize the model's variables.

Harvest rates above 0.07, if no antlered males were shot, and 0.10, if only antlered males were shot, initiated a decrease in population. Maximum sustained yield was estimated in the model to occur at 0.4 moose per km^2. Hunting was an additive mortality at densities below 0.4 moose per km^2. Hunting after the rutting period allowed a harvest rate 10% higher than before or during the rut. At harvest rates below 0.05, time of harvest relative to the rut was inconsequential. There was little benefit in distorting harvest sex ratio above 60% antlered males.

While hunting was an important mortality factor, moose populations in southeastern New Brunswick appeared to be ultimately driven by natural mortality factors and/or poaching of the adult cohort. The potential role of hunting in population dynamics is limited by the magnitude and timing of nonhunting mortality factors.

Determining Moose Activity Budgets Using Leg-Mounted Tip-Switch Transmitters and a Computerized Data Aquisition System

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ABSTRACT

Leg-mounted mercury tip-switch radio transmitters, used in combination with a computerized data aquisiion system (Telonic's, Inc.) were tested for the detection of 3 activity types for moose: lying, standing and walking. Transmitters were mounted on the lower front legs of 9 study animals by means of a nylon halter. Mercury switches were positioned such that signal pulse interval was long during standing, short during lying and variable during movement. The data aquisition system was programmed with frequencies to be sampled, sample period length, number of samples per sample period and time between samples.

Signal patterns predicted active and inactive bouts correctly 99.2% and 89.4% of the time, respectively. Error resulted when switches within the transmitters failed to trip when animals laid down, or when animals held their legs at an angle while feeding. Error was reduced by using a sampling design which optimized the detection of movement during active periods (3 minute sample periods) and allowed comparisons of consecutive samples such that samples containing ambiguous data could be reevaluated (15 minute intervals).

The number of steps taken within 808 15-second period were predicted within 1 step 95% of the time. Lengths of individual walking bouts lasting over 5 seconds were predicted with a high degree of accuracy.

The system was further tested during a study in which 189 24-hour activity budgets were obtained. The accuracy of estimating time spent walking, time spent active, and length of individual active and inactive bouts are reported.

EVALUATING MOOSE BROWSING PRESSURE ON KENAI NATIONAL WILDLIFE REFUGE

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Moose (Alces alces) browsing on aspen (Populus tremuloides), willow (Salix spp.), and paper birch (Betula papyriferia) was measured on 1000m point transects in two important wintering areas on Kenai National Wildlife Refuge, Alaska. These spring surveys measured the number and level of moose browsing from 1981-86. Moose browsed 45%, 86%, and 87% of the aspen, willow, and birch plants, respectively, at Slikok Lake. At Finger Lakes, moose browsed 61%, 90%, and 81% of the aspen, willow, and birch plants. On a relative scale, 1-lightly browsed (33%) to 3-heavily browsed (66%), aspen was browsed an average of 2.1 in both areas. Willow was browsed at an 2.6 and 2.7 level and birch was browsed at a 2.5 and 2.2 level at Slikok Lake and Finger Lakes, respectively. Aspen was the least preferred moose browse. Willow was slightly preferred over birch. Overall browsing was very great and by 1986 moose and snowshoe hare(Lepus americanus) feeding apparently caused browse plant clubbing. stunted growth, and mortality. Initially the browse utilization survey appeared to reliably estimate browsing presuure between plant species, wintering areas, and years. However because of changes in plant form due to heavy browsing, the technique became less reliable. The application of this survey and the affects of extensive moose browsing are discussed.

MICHIGAN'S TRANSLOCATED MOOSE:

THREE YEARS LATER

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Abstract: During January-February 1985 and February 1987, 25 bull moose (Alces alces) and 32 cow moose survived translocation from Algonquin Provincial Park, Ontario to Marquette County, Michigan. Mortality-sensing radiocollars on these animals have enabled researchers to necropsy dead animals, census calves, document movements and home ranges, and study winter bed site characteristics. By 29 January 1988, seven translocated cows had been killed by brainworms (Parelaphostrongylus tenuis). Three translocated bulls had succumbed to undetermined causes, and a fourth bull was killed by liver flukes (Fascioloides magna) and hydatid tapeworms (Echinococcus granulosus). In 1985, calf production was 21 animals, the twinning rate was 24%, and 81% of this cohort were recruited into the population. In 1986, calf production was 10 animals, the twinning rate was 43%, and recruitment of this cohort was 90%. In 1987, calf production was 30 animals, the twinning rate was 25%, and recruitment of this cohort was ____%. The postpartum population was 47 moose in 1985, 49 moose in 1986, and 103 moose in 1987. Information on movements and home ranges will be presented.

[Note: I will determine recruitment of the 1987 calf cohort in late April 1988.]

RWA/gav

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CALVING HABITATS OF MOOSE (ALCES ALCES)

Fifty-four calving sites of moose were located during the calving and early post-partum period in Algonquin Park, Ontario. Moose used a variety of hardwood, conifer, and open habitats for calving. Sites varied greatly in tree density, shrub density, shelter from weather, apparent abundance of browse, visibility around sites, and in proximity to water. Most sites were high on slopes and were in areas secluded from other moose and predators. Moose may choose specific sites as antipredator tactics. The wide variety of habitats used for calving may indicate that habitat needs are met within many habitats, at least within the Great Lakes-St. Lawrence forest zone. We recommend that the specificity of calving habitats be established within the boreal forest and that concerns for calving sites only be incorporated into timber management plans where the need is demonstrated.

VASCULARIZATION OF THE MOOSE

Alces alces BELL

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Abstract: The vascularization of the moose (Alces alces) bell was examined by gross dissection following injection of vinyl acetate into the arterial and venous systems and by X-ray photography. In a total of 28 heads, the bell artery originated from the left lingual artery in 15 (10 males, 5 females) and from the right in 13 (8 males, 5 females). The bell artery runs distally giving off a major branch to the dewlap and continues into the tail portion of the bell. The bell vein (3-5 mm lumen diam) originates in a capillary bed in the distal portion of the bell and runs proximally, adjacent to the bell artery. It receives one or two major branches from the dewlap and joins either the right or left jugular vein in the lower neck.

MOVEMENT PATTERNS OF TAGGED MOOSE FROM AN UNHUNTED AREA TO A HEAVILY HUNTED AREA

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Twenty-eight of 400 moose which were ear tagged within Algonquin Provincial Park, Ontario, have been recovered over a 4 year period. Interim distances are examined in relation to sex and age of animal as well as time since tagging. Inferences regarding optimal refuge size are discussed.

TOWARD CENTURY 21 - A MANAGEMENT PERSPECTIVE

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Toward Century 21 - the moose resource for the remainder of the century will be subjected to ever increasing pressure from a myriad of anthropogenic sources. The intent of this paper is to challenge and stimulate moose biologists, the public (naturalists, Treaty Indians and hunters) and industry to become involved in a co-operative management venture to ensure that the resource is available for future generations. New ventures, new ideas and new partners in moose management are a prerequisite for moose management as the 20th century draws to a close.

IN UTERO PRODUCTIVITY OF MOOSE IN MANITOBA

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Much information has been gathered via aerial surveys over the last 15 years in Manitoba on bull/cow and calf/cow ratios plus percentage of bulls, cow and calves within populations. Information on in utero productivity has been lacking and concern has been expressed that traditional bull only hunting seasons have resulted in fewer bulls and barren cows. A controlled hunting season on Hecla Island presented an opportunity to examine the reproductive tracts of all female moose taken - this paper details the results of this examination. In 1986, all hunters successful in obtaining a special permit to take female moose in selected areas of the Manitoba were asked to turn in the reproductive tracts of harvested animals for examination. The results of this examination are presented and reveal a significant sex ratio difference favouring females.